For Immediate Release
October 31, 2005

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Berkeley Lab Researchers Find Reliable Power Savings in Automated Demand Response Tests

Berkeley, Calif.—Using two different kinds of communication technology to test automated demand response during the summer of 2004, researchers at the Lawrence Berkeley National Laboratory found up to four MW of savings at 18 sites consisting of 36 buildings, according to a new report.

The research took place under the auspices of the Demand Response Research Center, which is funded by California's Public Interest Energy Research Program, and is led by Berkeley Lab's Environmental Energy Technologies Division.

Demand Response Defined

Demand response (DR) is a set of time-dependent activities that reduce or shift electricity use to improve electric grid reliability, manage electricity costs, and provide systems that encourage load shifting or shedding during times when the electric grid is near its capacity or electric prices are high.

Fully automated demand response (auto-DR) does not involve human intervention, but is initiated at a home, building, or facility through receipt of an external communications signal. The receipt of the external signal initiates pre-programmed shedding strategies. Facility staff at each site pre-programmed the control systems to receive the signals.

In testing performed during the summer of 2004, researchers used two different kinds of technology to test automated demand response on a larger set of 18 sites consisting of 36 buildings (10 million square feet of floor space): the price signal sent over the Internet to facilities computers, as in the first test, and a hard-wired Internet relay box.

The research team developed new technology to evaluate the capabilities of control and communications for automated demand response using energy management control systems (EMCS) and XML, the extensible Markup Language. The facilities participating in the test included several office buildings, a supermarket, cafeteria, industrial process sites, university library, and a postal processing and distribution center. All but two were in California. Those sites, in Canada and Wisconsin, participated to help the team better understand the behavior of the XML technology and the electric price server.

The team found that when the sites reach their maximum shed, a total of about 4 MW of fully automated demand response is available from these sites, as shown in the figure below. Demand savings reached more than one MW per site, with percent savings up to 42 % of whole-building power. Maximum savings per site reached 1.8 W/ft^2, with an average of 0.5 W/ft^2 and 14 % of the whole-building load.

According to Mary Piette, the Director of the Demand Response Research Center and leader of the research team, “This work has shown that today’s control and communications technologies can be used to deploy broad-scale demand response that is safe and secure with minimal investment. Automating demand response helps reduce the need for facility staff to manually control equipment in response to utility communications currently based on email, phone calls, and pagers.”

About one-third of California commercial building floor area is controlled by energy management control systems, which could be remotely accessed for automated demand response with this technology.

“The largest individual savings were observed from strategies that used a cooling zone set point increase,” adds Piette. Lighting, anti-sweat heaters, and other HVAC strategies also contributed to the savings.

The research team concluded “There is significant demand reduction potential in large buildings and commercial facilities during warm weather. There was only limited occupant awareness of the changes in the building environments, even with these large reductions in whole-building power.”

First Automated Demand Response Test in 2003

In 2003, researchers at Lawrence Berkeley National Laboratory completed the first successful test to evaluate automated demand response at five large building facilities in California. This was the first test in a group of large buildings to reduce electricity consumption using two-way internet-based communications.

The test used a fictitious electricity price similar to critical peak pricing to trigger the demand-response event over the internet, which is an example of what might be used in the future; no one touched any control systems during the tests. When a signal broadcast over the internet indicated that the price of electricity hit 30 cents/kWh, the buildings automatically began to lower demand by reducing lights, air conditioning, and other activities.

Two-way communications were used to observe that each site was listening to the price signal. When the Internet indicated that the price reached 75 cents/kWh, the buildings automatically took additional preplanned actions to further reduce demand.

Current and Future Research

Encouraged by the success, the research team initiated a new phase of testing during the summer of 2005, working with Pacific Gas and Electric Company (PG&E). About a dozen facilities are participating in fully automated Critical Peak Pricing Program (CPP).

During CPP events the facilities curtail their load in response to a price signal during periods of high summertime demand in exchange for a price break during off-peak hours. Unlike the earlier tests, the CPP program is a formal utility pricing program, so the use of automatic demand response technology here represents the first test of auto-DR within an existing utility program.

Berkeley Lab collaborated with Itron and PG&E to develop the automated technology between PG&E's CPP notification system and the automated price server.

The report, titled "Findings from the 2004 Fully Automated Demand Response Tests in Large Facilities," was authored by Mary Ann Piette, David S. Watson, Naoya Motegi, Norman Bourassa of Lawrence Berkeley National Laboratory (LBNL-58178). Download it at:

http://drrc.lbl.gov/drrc-pubs1.html

The objective of the Demand Response Research Center is to develop, prioritize, conduct, and disseminate research that develops broad knowledge to facilitate demand response. The Center is funded by the California Energy Commission's Public Interest Energy Research Program.

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